Applicant appreciates the careful consideration and favorable treatment of claims 8, 10, 11, 12 and 33 which were indicted as being allowed and claims 3, 5, 15, 16, 20, 22, and 24 stand objected to as being allowable if rewritten.

With respect to the Examiner's objection to the specification based on the assertion that the quantities listed in Table 1 are not labeled, etc., Applicant respectfully has amended Table 1. More specifically, Table 1 is a complete listing created by commercial optics design software "Code V" TM by Optical Research Associates (ORA). See the "CODE V> Lis" line in the table. The listings and headings in the table are conventional and well know in the art. The first column underneath ">Obj "for: Object plane) is the surface number 1 to 45, plus "IMG" for image plane. The second column is "RDY" for radius. The third column is "THI" for thickness and the fourth column "RMD" indicates reflective surface (REFL) where appropriate. The fifth column "GLA" indicates the glass sort, here all "CAF-UV" means $CaF_2$, ultraviolet grade. CCY, THC, GGL are not relevant.

For aspherical surfaces, below their numbered listing there is an insert "ASP:" giving the parameters of the standard asphere expansion formula. Only K (conical constant, of German Konus), A, B, C, and D are relevant.

The term "SPECIFICATION DATA" gives additional information: "NAO" is numerical aperture at object side; "DIM" is dimensions in "mm" –millimeters; "WL" is wavelength; "REFRACTIVE INDICES" gives the refractive index of $CaF_2$ taken as given quantity for the calculation, here n = 1.558410 at center wavelength of 157.63 nm and n = 1.558409 and n = 1.558411 at wavelength limits taken for achromatization control.

Other indications also are CODE V standard and not relevant here. Applicant respectfully submits that this understanding of CODE V TM listings is generally known in the art and therefore, Applicant respectfully submits that further explanation or definitions are not required and therefore are not supplied. If the Examiner is not fully satisfied with the above explanations, Applicant respectfully traverses this objection since Table 1 is laid out in a conventional manner and uses conventional terminology and therefore does not require that each abbreviation be spelled completely out since one of skill in the art fully comprehends such Tables, as further evidenced by these Tables appearing in issued U.S. patents.

Claims 1, 6, 7, 9, 13, 18, 21, 23, 25, 26, 28, 31 and 32 stand rejected under 35 U.S.C. 102(b) as being anticipated by Williamson.

With respect to the rejection of claim 1 as being anticipated by Williamson, Applicant respectfully traverses this rejection on the following ground. Claim 1 recites a microlithographic reduction projection catadioptric objective with one of the features being an aperture plane on an image side of a most imageward curved mirror. This rejection is based on a broad interpretation of the term "aperture plane"; however, Applicant respectfully contends that the term "aperture plane" is defined in the exhibit as being equivalent to "pupil plane", cf. [0018], [0025] paragraphs in the specification. Projection objectives between object plane and image plane generally have (at least) one pupil plane = aperture plane, known to be a "Fourier transform" plane of the object/image field planes. See also [0007], "obscuration of the aperture". This is not any plane, where any sort of stop is located. Lexical ambiguity is to be interpreted properly from the specification. Those skilled in the art routinely can calculate the

location of the aperture plane from the CODE V ™ data of table 1 and can take it from the beam paths in the drawings, e.g., at mirror M1 in Fig. 1.

The aperture plane is therefore not any plane that is selected of free choice but rather is a plane that is identified by the laws of nature as set forth in the definition in the Exhibit. In contrast, Williamson does not disclose an aperture as set forth in the claim (on the image side of a most imageward curved mirror) and in accordance with the definition set forth by the Applicant in the Exhibit.

Claim 6 stands rejected under Williamson. Claim 6 recites a microlithographic reduction projection catadioptric objective and this claim has been amended to recite that the "cataoptric or catadioptric group as a whole provides a virtual image. This feature is not found in Williamson and in fact, Williamson discloses an arrangement where M5", M6" group as a whole produces a real image as the exiting beams are convergent. Because the cataoptric or catadioptric group as a whole provides a real image and not a virtual image, at least one feature in claim 6 is not disclosed in the cited Williamson reference and therefore, this ground of rejection should be withdrawn.

Claim 9 should be allowed as depending from what should be an allowed independent claim 6.

Claim 7 recites a microlithographic reduction projection catadioptric objective that includes in sequence from the object side to the image side, a field lens group, a catadioptric group including one or more negative lenses and a concave mirror, a group having an odd number of curved mirrors and a positive lens group. Applicant respectfully submits that the Williamson reference fails to include the field lens group that is recited in claim 7. The term "field lens group" is well defined and Applicant has

taken the liberty of enclosing, as Exhibit B, several handbook definitions. As is well known in the art and set forth in Exhibit B, the term "field lens group" is defined as a lens at or close to a field plane.

Applicant respectfully submits that this feature is not present in the Williamson reference. Lens R1 of Williamson's Fig. 3 is far distant from field plane 10 (reticle plane). The beam from one object point is spread far, about equal to the maximum object height at the field plane. Applicant respectfully submits that this is a clear indication that this lens R1 cannot be a field lens. Williamson repeatedly recites the term <u>field mirror</u> (e.g., claim 1) but never the term "field lens". The function of R1 is only described in column 6, lines 16-18, collectively with R1-R3 to "reduce residual abberations". Consequently, Williamson may show a lens between the reticle and the first mirror but in no way teaches that it would be a <u>field lens</u>. Claim 7 recites a field lens group and lens R1 of Williamson is not part of a field lens group, as defined herein. Since one or more features of claim 7 are not disclosed by Williamson, the rejection of claim 7 is improper and should be withdrawn. Based on the foregoing, Applicant respectfully requests reconsideration and allowance of claim 7.

Claim 13 recites a microlithographic reduction projection catadioptric objective in which one of the features is that "no more than one optical element that is in a substantially non-rotationally symmetric form" is essential. Williamson in the cited column 6, lines 14-16, addresses the mirror <u>surface curvatures</u>, while the present claim 13 addresses the term "form" addresses the whole physical part, namely its envelope. Applicant draws the Examiner's attention to the fact that in Williamson's Fig. 3, all mirrors need to be cut off at one side, e.g., mirror m3" is cut off far from the optical - i.e.,

symmetry- axis, otherwise it would block light beams from reaching M5", R3, wafer. Note that only its surface curvature 16" as the drawn dotted line is axially symmetric. This is also described in the present specification part [0004] and in [0030], which Applicant draws the Examiner's attention to.

Based on the foregoing, reconsideration and allowance of claim 13 are respectfully requested.

Claims 18, 21, 23, 25, 26, 28, 31, and 32 should be allowed as depending from what should be allowed independent claims. Applicant respectfully submits that Williamson in no way can make these claims obvious since the reference discloses an objective of completely different look and feel, which is really a EUV catoptric objective just fitted with some distributed corrector lens elements to show an enabling disclosure for established UV light sources.

Claims 2, 14 and 19 stand rejected as being anticipated by Takahashi et al. Applicant respectfully traverses this ground of rejection for the following reasons.

Claim 2 recites a microlithographic reduction projection catadioptric objective having an object side and an image side and curved mirrors. Thus, it is clear from claim 2 that a plural number of curved mirrors are required. Takahashi only has one curved mirror $M_c$ in Figs. 1 and 3, while claim 2 recites a plural number of mirrors. A single curved mirror is not claimed. Also, after the only curved mirror Mc and between this and the next lens $L_c$, the beam obviously <u>converges</u>. Later influences are of no relevance for the claim.

Applicant respectfully traverses the rejection of claim 2 for the foregoing reasons and the rejection of claim 2 under 35 U.S.C. 102(b) should be withdrawn as the

Takahashi reference fails to include at least one of the claimed features, namely, plural curved mirrors. Allowance of claim 2 is in order.

Claim 14 should be allowed as depending from what should be an allowed independent claim 2.

Claim 19 should be allowed as depending from what should be an allowed independent claim 2. Further, the Examiner's understanding of "a virtual image is formed by $M_2$" is erroneous since $M_2$ is planar and therefore cannot form any sort of image.

Takahashi clearly tells about the intermediate image in column 2, lines 55-61, claim 1(a),(b) and claim 5(a),(b) clearly tell that the intermediate image is formed upstream of the second mirror in the optical path, namely planar mirror $M_1$. Applicants respectfully contend that the claims are not novel over Takahashi but they are also not obvious in view of this reference since the reference shows a distant generic form of an objective with exactly one concave mirror, necessitating planar folding mirrors.

Claims 4, 17 and 27 stand rejected under 35 U.S.C. 102(b) as being anticipated by Sato et al. Applicant respectfully traverses this rejection on the following grounds.

Sato is of a third generic type of catadioptric objectives as described in [0007] of the present specification.

Claim 4 recites a microlithographic reduction projection catadioptric objective includes a system having a system with an unobscured pupil. In claim 4, the term unobscured pupil is significant. The Examiner recites Fig. 10 of the third embodiment which is described at column 9, beginning on line 7. Here the description of

an objective per se, as claim 4 does, is mixed up with very distinct restrictions to the illumination cf., column 9, lines 55-61 "light source 20 emits coherent rays...The...rays are composed of convergent rays... they converge on the center C of curvature of the phase compensation plate 15", as well as with special features of an object to be imaged - cf., column 9, line 62 ff. "O-order diffracted light D0....and the higher-order diffracted lights are discharged from the object 19."

By the laws of physics and optics, the angle at which a beam diffracted at a structure leaves with respect to the O-order is proportional to the inverse of the grating pitch as is commonly known in the art. So, the Sato description of the embodiment of Fig. 10 exactly only fits for a circular grating with a narrow band of pitches (near the resolution limit of the arrangement). The pitch getting broader, the angle of the exit from the reticle reduces and the place of incidence at the pupil plane 15 wanders inward. From some pitch dimension onward, this location is so much inward, that the outgoing beam strikes the back surface of mirror 16. Consequently, a set of pitches of the reticle, diffraction angles, locations in the pupil/aperture plane is obscured from reaching the image plane.

It is not relevant, that this obstruction is effected by an obstacle located outside the aperture/pupil plane, as is well established for outer cutoffs under the term "vignetting". Such obscuration commonly is effected by objects outside a pupil/aperture plane, see e.g., the document cited in paragraph [0007] of the present specification, which issued as U.S. patent No. 6,169,627, where (cf. Fig. 1/Table 1) diaphragm 22 is located midway between the mirrors 21, 23, while their central bores define the central obscurations, i.e., the angular distribution from the object which cannot reach the image

via the mirrors. Moreover, the mirrors of Sato with a central bore are considered to be of "substantially disk form" as are those of the [0007] reference, as the central bore as with a wheel with a bore for its axle does not deviate it from a disk.

Based on the foregoing, Applicant respectfully requests reconsideration and allowance of claim 4.

Claim 17 has been amended into independent form and as a result, the claim should be allowed as depending from what should be allowed independent claims.

Claim 27 should be allowed as depending on what should be an allowed independent claim 4.

Claim 29 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Takahashi et al. in view of Williamson. Claims 30 and 34 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. in view of Takahashi et al.

Applicant traverses these rejections on a number of grounds. More specifically, the combination of these references is improper since each reference belongs to a different kind of objective, namely, Williamson is of the type described in [0004] to [0006] in the specification; Sato is of the type described in [0007]; and Takahashi is of the type described in [0008], [0009]. The Examiner gives no reasons why one of skill in the art would have expected the others [references] to give relevant information to be combined advantageously.

Further, claims 29, 30 and 34 should be allowed as depending from what should be an allowed independent claim.

Allowance of claims 1-45 is earnestly solicited at this time.

It is believed that the present Amendment is fully responsive to the outstanding Office Action. If there are any other issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Respectfully submitted,

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## MARKED UP COPY OF THE AMENDED CLAIMS

### IN THE SPECIFICATION

Page 1, please replace the paragraph beginning with "Cross-Reference" with the following paragraph:

Cross-Reference to Related Applications[- Not applicable] : The present application claims the benefit of U.S. patent application serial No. 60/176,190, filed January 14, 2000.

Page 3, please replace the paragraph beginning with "In the simplest" with the following paragraph:

In the simplest version of this new front end, set up to be part of a -0.25 reduction[.], 0[,].75 image side NA system with a 7 mm x 26 mm rectangular image field size, the optical elements are shown in the lens section of Fig. 1. This catadioptric partial system provides a virtual image on the right hand side, which has enough axial chromatic aberration to compensate for a conventional focusing lens group that forms a 0.75 NA image. A real pupil or aperture plane is formed on the right hand end of the system. The system shown has enough Petzval sum so that the focusing lens group can be made up mostly of positive power lenses.

## IN THE CLAIMS

6. (Amended) A microlithographic reduction projection catadioptric objective having an object side and an image side, consisting in sequence from the object side to the image side of a catadioptric group providing a real intermediate image, a catoptric or catadioptric group as a whole providing a virtual image, and a dioptric group providing a real image.

17. (Amended) [A microlithographic reduction projection catadioptric objective having an object side and an image side,] The objective of claim 1, wherein [a] the most imageward mirror is convex.

## EXHIBIT A- DEFINITIONS

Planar folding mirrors: This term is multiply explained in the specification with references, see [0008], [0009], [0030], [0036], where it is understood that folding mirrors are planar regularly, as otherwise they would influence image generation (cf. [0031]). (cited in the published application). The term "planar" is only put in the claims for more clarification.

Aperture plane: This is equivalent to "pupil plane", cf. [0018], [0025].

Projection objectives between object plane and image plane generally have (at least) one pupil plane = aperture plane, known to be a "Fourier transform" plane of the object/image field planes. See also [0007], "obscuration of the aperture". This is not any plane, where any sort of stop is located. Lexical ambiguity is to be interpreted properly from the specification. Those skilled in the art routinely can calculate the location of the aperture plane from the CODE V ™ data of table 1 and can take it from the beam paths in the drawings, e.g., at mirror M1 in Fig. 1.

Most imageward is meant optically and not mechanically.

Unobscured pupil is the same as "unobscured system aperture", see "aperture plane" above.

See [0007] "central obscuration of the aperture" in the cited art. The claims language "unobscured pupil" is the requested opposite of this feature of the known art.

A straight axis of symmetry cf. [0004] "all optical surfaces are symmetric to a common axis" - the meaning is the same. Cf. [0030], [0031] constructive advantages of this.

Negative/positive reduction ratio "ratio" is the scale of imaging and "reduction" is making smaller-in contrast to magnification, as from the preamble "....reduction projection...objective".

Imaging ratio is optics is defined to be negative if the image is inverted - as with a single lens or with any objective without or with an even number of intermediate images. Prism telescopes therefore have erecting prisms as substitute image erectors.

The ratio is positive, if the image is "erect", what is caused by an even number of subsequent imagings, so that the number of intermediate images is odd.

The catadioptric groups (FE, FE') of the embodiments show one intermediate image (IMI), see Figs. 1-3, the refractive part (TGF, FLG') has none. So these by definition have positive (reduction) ratio for FE, FE'. Negative (reduction) ratio for TFG, FLG'.

complete overlap to the point at which they are just separate.

**eyepiece, integrating** A *focusable eyepiece* equipped with a *graticule* in the form of a grating carrying lines, crosses, or points of known separation, used to facilitate *modal analysis* and evaluation of stereological parameters.

**eyepiece, internal-diaphragm** An eyepiece in which the *field diaphragm* is located between the *field lens* and the *eyelens* in the *front focal plane* of the eyelens.

**eyepiece, Kellner** An improved type of *Ramsden eyepiece*, in which the *eyelens* is an *achromatic doublet*.

**eyepiece, locating flange of** The flange on the *eyepiece* which locates it at a given level (that of the *eyepiece-locating surface of the viewing tube*). It is one of the reference planes for the *parfocalizing distance of the eyepiece* (see Fig. 2).

**eyepiece, micrometer** A *focusable eyepiece* used for measuring. In its most common form a measuring *graticule* is fitted in the *primary image plane*. It must be calibrated against a *stage micrometer*.

**eyepiece, micrometer-screw** A type of *micrometer eyepiece* in which reference marks in the *primary image plane* may be adjusted by means of a micrometer screw; the resultant indicated displacement is used to derive dimensions.

* **eyepiece, negative** Not a true *eyepiece* in the original meaning of the word, but a *diverging lens* acting as a *projection lens* and used mainly in *photomicrography*. It is not usable for visual observation, since its *exit pupil* is located within the system and is thus not accessible to the *pupil* of the observer's *eye*. An old and incorrect term for an *internal diaphragm eyepiece*. (*See also* **eyepiece, Homal**)

**eyepiece, orthoscopic** *See* **eyepiece, Kellner**

**eyepiece, parfocalizing distance of** *See* **parfocalizing distance (of eyepiece)**

**eyepiece, pointer** An *eyepiece* containing a *plane* serving to indicate *objects* of interest in the *field of view*.

* **eyepiece, positive** An old and incorrect term for an *external diaphragm eyepiece*.

**eyepiece, projection** Not a true *eyepiece* in the original meaning of the term, but a *lens* designed to project an *image* at a finite distance.

**eyepiece, Ramsden** The original type of *external-diaphragm eyepiece* in which the separation and *focal lengths* of the *lenses* provided achromatism.

**eyepiece, slotted** [pol.] An *eyepiece* containing a slot into which a *retardation plate* or other device may be inserted.

**eyepiece, widefield** An *eyepiece* specially computed to provide a *field of view* greater than that of a normal eyepiece of the same *magnifying power*.

**eyepiece graticule** *See* **graticule, eyepiece**

**eyepiece-locating surface (of viewing tube)** The surface at the upper end of the *viewing tube* which sets the level of the *locating flange of the eyepiece*. It is one of the reference planes which determines the *mechanical tubelength*. (See Fig. 2.)

**eyepoint** *See* **microscope, exit pupil of**

**eyepoint height** The distance measured along the *optical axis* from the last surface of the *eyepiece* to the *eyepoint*. Its value may be affected by optical systems which are inserted between *objective* and eyepiece.

# F

**factor, extinction** *See* **extinction factor**

**factor, luminance** *See* **luminance factor**

**far-point distance** *See* **distance, far-point**

**far point of the eye** [physiol.] The point at which the naked eye is focused when it is unaccommodated (i.e. with its lowest *refractive power*). This distance from the eye depends on possible refractive errors

**farsightedness** *See* **hypermetropia**

**fibre optic** A bundle of very fine, optically insulated glass or plastic fibres used to conduct *light*. They may serve for *illumination* or for *image* transmission.

**fibre optic illuminator** *See* **illuminator, fibre optic**

**field** An area in the *object plane* or any other plane conjugate with it. The term may be qualified by its location (e.g. *object field*, *image field*) or its function (e.g. *illuminated field*, *photometric field*).

**field, depth of** *see* **depth of field**

**field, illuminated** That part of the *object field* which receives *illumination*.

**field, image** Any *field* in which an *image* of the *object* is formed.

**field, object** That part of the *object plane* which can be surveyed at any one time. Its *image* is delimited by the *field diaphragm*.

**field, photometric** That part of the *image field* from which a photometric measurement is made at any one time.

**field, surrounding** (1) That part of the *field of view* surrounding the object of vision. (2) That part of the field of view surrounding any *object*.

**field, visual** *See* **field of view**

**field diaphragm** *See* **diaphragm, field**

**field lens** A *lens* positioned in or close to a *field plane* in order to adapt the *exit pupil* of the preceding lenses to the *entrance pupil* of subsequent lenses. This suppresses vignetting in the *image* and, more generally, provides homogeneous *illumination* of the *field* to which it relates.

Note: The term is, unfortunately, often used without qualification to describe the field lens of the eyepiece.

**field microscope** *See* **microscope, portable**

**field of view** That part of the *image field* which is imaged on the observer's *retina*, and hence can be surveyed at any one time.

**field-of-view number** A number which specifies the *field of view* of an *eyepiece*. It is the actual diameter in millimetres of the *field diaphragm* in an *external-diaphragm eyepiece* or the apparent diameter of the *virtual image* of the field diaphragm in an *internal-diaphragm eyepiece*.

Note: The field-of-view number is now one of the standard markings of the eyepiece and may be used to calculate the diameter of the object field.

**field plane** *See* **plane, field**

**figure, conoscopic** *See* **conoscopic (interference) figure**

**figure, polarization** [pol.] The qualitative estimation of deformations of the *extinction cross* during rotation about the *optical axis* of an *optically aniotropic* specularly reflecting surface due to the influence of anisotropism.

Note: The phenomenon is used to identify ore minerals.

**filament** The emissive element of an incandescent electric *lamp*; usually made in the form of a coil of tungsten wire heated by the passage of an electric current. In low-voltage lamps this coil is often flattened to decrease the depth of the coil in the direction of the *optical axis* and to increase the *luminance*.

**filament lamp** *See* **lamp, filament**

**filar micrometer** *See* **eyepiece, micrometer-screw**

**filter** An optical device designed to control selectively a given range or all of the *wavelengths*, *colour temperature*, *vibration direction*, and/or *intensity* of the *radiation* which it transmits or reflects.

**filter, barrier** A *filter* used in *fluorescence microscopy* which is designed to prevent the passage towards the *image* of those *wavelengths* of *light* used for excitation but to allow the light produced by *fluorescence* of the *specimen* to pass.

**filter, broad-band-pass (or broad-band)** A *filter* which allows the passage of *radi-*

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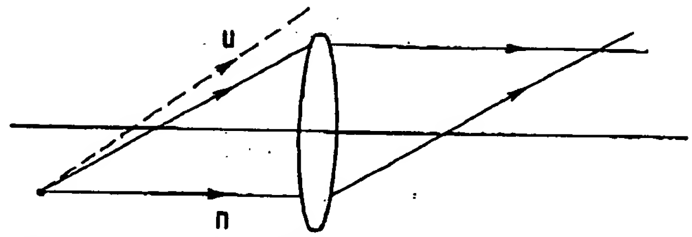

**FIGURE 27** Example of vignetting. The dashed ray passes through the aperture, but misses the lens.

### Vignetting

*Vignetting* occurs when an image-forming bundle is truncated by two or more physical structures in different planes, Fig. 27. Typically, one is the nominal aperture and another is the edge of a lens. Another case is that of central obstructions away from the aperture. When vignetting occurs, the image irradiance is changed, and its diminution with field height is faster than it otherwise would be. Aberration properties are also changed, so vignetting is sometimes used to eliminate light that would unacceptably blur the image.

### Lens Combinations and Field Lenses

When lenses are used to relay images, the light is transferred without loss only if the exit pupil of one corresponds with the entrance pupil of the next. An example of the failure to meet this requirement is shown in Fig. 28. The axial point is reimaged satisfactorily, but off-axis bundles are vignetted. To transfer the light properly, a *field lens* in the vicinity

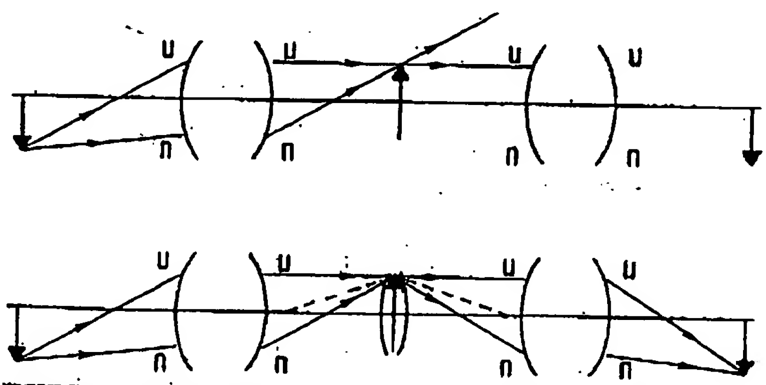

**FIGURE 28** A pair of lenses relaying an image with and without a field lens. In the top figure, there is no field lens, and some of the light forming the intermediate image does not pass through the second lens. The amount lost depends on the two numerical apertures and increases with distance from the axis. In the lower figure, a field lens at the intermediate image forms an image of the exit pupil of the first lens into the entrance pupil of the next. No light is lost unless the numerical aperture of the second lens is less than that of the first.

of the intermediate image is used to image the exit pupil of the preceding lens into the entrance pupil of the next one. If the field lens is a thin lens in the image plane, then its magnification with respect to the image is unity. In practice, the field lens is usually shifted axially, so scratches or dust on its surface are out of focus. Its magnification then differs from unity. The focal length of a thin field lens in air is given by $1/f' = 1/a + 1/b$, where $a$ is the distance from exit pupil of first lens to the field lens, and $b$ is that from field lens to the entrance pupil of the second lens. The exit pupil is reimaged with a magnification $b/a$. If the sizes of the various pupils and their images are not matched, then the aperture of the combination is determined by the smallest. Field lenses affect aberrations.

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## Defocus

When the object and image-receiving surface are not conjugate there is *defocus*. If either the object or the receiving surface is considered to be correctly positioned, the defocus is associated with the other. Another situation is that in which the object and receiving surfaces are conjugate, but both are wrongly located, so that the image is sharp but the magnification is not what is desired, a condition that might be called *misfocus* (NS).

Defocus has two basic geometric effects, if there are no aberrations, Fig. 29. One is blurring, since the rays from an object point do not converge to a single point on the receiving surface. The blur size varies linearly with the axial defocus in image space and with the cone angle of the image-forming bundle. The shape of the blur is that of the exit pupil, projected on the receiving surface. The other effect of defocus is a lateral shift in position of the blur's centroid relative to that of the correctly focused point. The shift depends on the chief ray angle on the side of the lens where the defocus occurs. In the simplest case, the shift is approximately linear with field height, so acts as a change of magnification. If the object is tilted or is not flat, the effects of defocus vary across the field in a more complicated way. Aberrations affect the nature of the blur. With some aberrations, the blur is different on the two sides of focus. With spherical aberration, the blur changes in quality, and with astigmatism the orientation of the blur changes.

In considering the geometrical imaging of a small region of a lambertian object, there is an implict assumption that the pupil is filled uniformly with light. In imaging an extended object that is externally illuminated, the light from a given region may not fill the pupil uniformly, so the character of the blurring is affected by the angular properties of the illumination and scattering properties of the object.

The amount of defocus can be described in either object or image space, and it can be measured in a variety of ways, for example, axial displacement, displacement along a chief ray, geometrical blur size, and wavefront aberration. The axial displacements in object

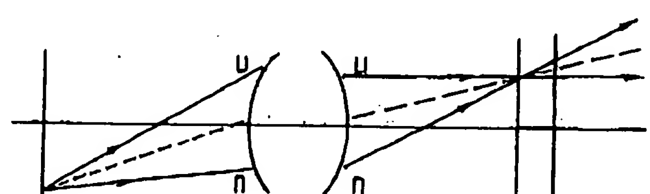

**FIGURE 29** Defocus of the receiving surface. A receiving surface is shown in focus and shifted axially. The image of a point on the shifted surface is blurred, and its centroid is translated radially.

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